Filling the Gaps
Climate and Weather Information for Small- and Medium-size Water Utilities

Appendices

July 2019–October 2020

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Funding provided by the NOAA Water Initiative and the Water Research Foundation

Project Method and Description

Project Goal

This workshop series was designed by the National Oceanic and Atmospheric Administration (NOAA), and the Water Research Foundation (WRF) to improve the delivery of information resources for small- to medium- size water system managers, with the goal of building their resilience to climate change. Each workshop is organized by NOAA's regional partners and are tailored to address issues identified by and for each region. The workshops provided a forum to exchange ideas to:

- Identify gaps and improve NOAA climate and weather-related tools and informational resources;
- Raise regional-scale awareness of NOAA water tools and resources;
- Build regional connections that support small-scale utility decision making; and
- Develop and foster improved communication materials to make NOAA's information and tools more accessible.

Methods

Each workshop was organized by a NOAA regional partner with the exception of the Pacific Northwest workshop which was organized by the University of Washington; and workshops were organized, in consultation with the workshop series management Team. Regional leads were asked to reach out to community drinking water and wastewater utilities, stormwater managers, urban planners, etc. serving less than 100,000 customers, in order to design agendas according to regional interests and preferences. As a result, every workshop was different, varying in length, number of sessions, agendas, and in one case, one-on-one interviews in place of a workshop. Also, initially, workshops were intended to be in person, but after one workshop in Washington, D.C. the remaining six were reorganized as virtual events due to the COVID-19 pandemic. As a result, it was possible to invite more participation from throughout each Region.

Four-page summaries were produced for each regional workshop, and are considered standalone documents for regional use. In addition, all lessons learned, information needs, and other information were compiled into unified documents for future use by NOAA and its partners. Specifically, the information needs compendium will be used by NOAA to share throughout NOAA and the research community to improve delivery of tools and information to the water sector useful for climate resilience; the lessons learned compendium will be used for creating messaging and improving outreach generally, and will be mined for use in journal articles and other publications in order to share the information more broadly; etc. Finally, to document the entire workshop series process, three appendices are being made available for others interested in particular details - this Appendix, Appendix 2 containing workshop agenda details, and Appendix 3 containing a comprehensive list of acknowledgments.

Project Leads

NOAA and the Water Research Foundation wish to express our sincere appreciation to everyone who participated in this workshop series. Following is the list of primary leads, but please see Appendix 3 for the complete list of everyone we wish to acknowledge including speakers, advisors, and associates who were all crucial to the success of this project.

Workshop Series Management Team

- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program
- Ellen Mecray, Regional Climate Services Director, Eastern Region, NOAA National Centers for Environmental Information
- Tamara Houston, National Partnership Liaison, NOAA National Centers for Environmental Information
- Maureen Hodgins, Regional Liaison, Water Research Foundation

- Katy Lackey, Senior Program Manager, US Water Alliance
- Karen Metchis, Editor, Contractor, ACQ Consulting

Equity Lead Planning Team

- Katy Lackey, Senior Program Manager, US Water Alliance
- Zoe Roller, Senior Program Manager, US Water Alliance
- Gina Wammock, Senior Fellow, US Water Alliance
- Deborah Lee, Director, NOAA Great Lakes Environmental Research
- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program

GLISA Lead Planning Team

- Kim Channell, Great Lakes Integrated Sciences and Assessments
- Jenna Jorns, PhD, Great Lakes Integrated Sciences and Assessments
- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program

MARISA-CCRUN Lead Planning Team

- Franco Montalto, Consortium for Climate Risk in the Urban Northeast (CCRUN), Drexel University
- Korin Tangtrakul, Consortium for Climate Risk in the Urban Northeast (CCRUN), Drexel University
- Debra Knopman, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the RAND Corporation
- Jordan Fischbach, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the RAND Corporation
- Krista Romita Grocholski, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the RAND Corporation
- Michelle Miro, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the RAND Corporation
- Ellen Mecray, Regional Climate Services Director, Eastern Region, NOAA National Centers for Environmental Information

NRCC Lead Planning Team

- Jessica Spaccio, Northeast Regional Climate Center (NRCC)
- Ellen Mecray, Regional Climate Services Director, Eastern Region, NOAA National Centers for Environmental Information

PNW Lead Planning Team

- Guillaume Mauger, PhD, University of Washington, Climate Impacts Group
- Heidi Roop, PhD, University of Minnesota, Department of Soil, Water, and Climate
- Julie Tolmie, University of Washington, Climate Impacts Group
- Maureen Hodgins, Regional Liaison, The Water Research Foundation

SCIPP Lead Planning Team

- Amanda Lewis, Southern Climate Impacts Planning Program, Louisiana State University
- Vincent Brown, PhD, Southern Climate Impacts Planning Program, Louisiana State University
- Clay Tucker, Facilitator, Louisiana State University
- Ashlee Autore, Graduate Student, Louisiana State University
- Marisa Karpinski, Graduate Student, Louisiana State University
- Derek Thompson, Graduate Student, Louisiana State University
- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program

SERCC Lead Planning Team

- Sandra Rayne, Ph.D., Regional Climatologist, Southeast Regional Climate Center
- Charles E. Konrad, Ph.D., Southeast Regional Climate Center, Carolinas Integrated Science and Assessments
- Tamara Houston, National Partnership Liaison, NOAA National Centers for Environmental Information

WWA Lead Planning Team

- Benét Duncan, PhD, Western Water Assessment (WWA), Cooperative Institute for Research in Environmental Science (CIRES), University of Colorado
- Seth Arens, PhD, WWA, CIRES, University of Colorado and University of Utah, University Water Center, Global Change and Sustainability Center
- Lineke Woelders, PhD, WWA, CIRES, University of Colorado
- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program

Tools Demonstrated and Discussed

*Tools are from NOAA unless otherwise indicated.

Atlas 14 Point Precipitation Frequency Estimates
Climate Explorer
Climate Toolbox (Climate Impacts Research Consortium, Climate Adaptation Science Center)
CLIMPER Climate Perspectives (SERCC)
Colorado Climate Center (Colorado State University)
Creating Resilient Water Utilities (USEPA)
Colorado Basin River Forecast Center
Dos and Don'ts for Using Climate Change Information for Water Resource Planning and Management (Vano, et al)
Drought.gov
Drought Response & Recovery Guide (USEPA)
Engineering Case Studies (WUCA)
Experimental Extreme Precipitation Monitor
Extreme Precipitation In New York and New England - historical (NRCC)
Climate Data Online - Historical Weather Observations
IDF Curves for New York State - projected (NRCC)
Intermountain West Climate Dashboard (WWA)
Leading Practices Guide (WUCA - forthcoming)
Mountain West Climate Services Partnership (Aspen Global Change Institute)
National Stormwater Calculator (USEPA)
National Water Model
Northeast River Forecast Center
Northwest Climate Toolbox Workbook (Pacific Northwest Climate Impacts Resource Center)
Quantitative Precipitation Forecasts
Simple Planning Tools for Oklahoma Climate Hazards (SCIPP)
Snowpack Monitoring in the Rocky Mountain West: A User Guide
Southeast Multi Sensor Precipitation Estimates (SERCC)
Tides and Currents
Tropical Cyclone Outlooks
U.S. Climate Resilience Toolkit
U.S. Drought Monitor
Water Resources Dashboard
Water Resources Dashboard Story Map (Climate Information for Water Utilities)
Water Utility Climate Alliance Online (WUCA)
Wet-Bulb Globe Temperature (WBGT) Heat Tool

Attendance Details

Approximate Total Participants: ~ 900

	State/ Local	Univ.	NGO	Private	Fed*	Total
CCRUN-MARISA	60%	20%	7%	7%	7%	100%
Equity	14%	36%	11%	10%	29%	100%
SCIPP	50%	8%	8%	25%	8%	100%
GLISA	60%	9%	6%	17%	9%	100%
WWA	57%	14%	14%	14%		100%
PNW	68%	4%	8%	16%***	4%	100%
SERCC	100%					100%
NRCC#						**100%**
AVG	**44%**	**13%**	**8%**	**13%**	**8%**	**100%**

* National and Regional federal employees
** couldn't discern affiliation
*** .coms assumed to be private sector but may be other
# affiliations unknown

Equity ~70
- State and Local Governments: 10
- Universities: 25
- NGOs: 8
- Private Sector: 7
- Federal Government: 20

GLISA ~175
- State and Local Governments: 105
- Universities: 15
- NGOs: 10
- Private Sector: 30
- Federal Government: 15

MARISA-CCRUN ~75
- Local Governments: 45
- Universities: 15
- NGOs: 5
- Private Sector: 5
- Federal Government: 5

NRCC ~ 270
- 530 total connections;
- Avg. 130 per webinar x 4
- 269 Unique participants
- Orgs. Unknown

SERCC ~ 7 utility interviews; ~ 12 people

PNW ~170
- 197 Connections (Avg. 66 x 3 Webinars) + pre-workshop focus groups (26); survey respondents (122)
- State and Local Governments: 85
- Universities: 5
- NGOs: 10
- Private Sector: 20
- Federal Government: 5

SCIPP ~60
- Local Governments: 30
- Universities: 5
- NGOs: 5
- Private Sector: 15
- Federal Government: -5

WWA ~70
- State and Local Governments: 40
- Universities: 10
- NGOs: 10
- Private Sector: 10
- Federal Government: 0

Summary of Workshop Formats and Attendance

5 of 8 had science presentations [all except SERCC, PNW, Equity]
1 emphasized technical information [CCRUN-MARISA]
6 of 8 had tools demos [all except SERCC, Equity]
5 had case studies and 3 had panels instead of cases studies
1 featured utility peer experiences [PNW]
1 was only one-on-one interviews [SERCC]

Equity – one 1-hr session (SCIPP) plus one 2-hr. session in the Great Lakes including case studies

GLISA – One 3-hr. Webinar - Science, Tools presentations, Tools café, Tools survey, Panel with Q&A

MARISA-CCRUN – 1.5-day in person workshop – Preworkshop survey, Science and technical overviews, Case studies, Tools cafes, Interactive discussions, Polling

NRCC – Four 2-hr. Webinars, (3) Pre-workshop webinars – Science, Tool demos, Case Studies, Hands on breakouts

PNW – Three 1.5 hr. Webinars with case study and tools presentations and Q&A; pre-workshop focus groups and survey

SCIPP – One 5-hr Webinar - Science presentations, Tools demos, Case studies, Equity presentation, Discussions

SERCC – One on one interviews; debrief with team

WWA – Two 3-hr. Webinars - Science presentations, Tool demos, Panel discussion, Breakout session Discussions.

Detailed Workshop Agendas

Equity - Agenda

one 1-hr session (SCIPP) plus one 2-hr. session (GLISA)

1:00pm Welcome and Introductions
Deborah Lee, Director, NOAA Great Lakes Environmental Research
Katy Lackey, Senior Program Manager, US Water Alliance

1:10pm An Equitable Water Future
Zoe Roller, Senior Program Manager, US Water Alliance
Introduction to water equity, why it matters for resilience, and key vulnerabilities to consider.

1:20pm Five Priority Actions for Equitable Resilience
Katy Lackey, Senior Program Manager, US Water Alliance
Overview of priority actions that help water and climate professionals build resilience.

1:30pm Case Example: Milwaukee, WI
Yvonne McCaskill, Coordinator, Century City Triangle Neighborhood Association
Lisa Sasso, Senior Project Planner, Milwaukee Metropolitan Sewerage District (MMSD)
Utility-community partnerships for climate resilience planning and stormwater management.

1:50pm Q&A with Milwaukee Team
Facilitator: Katy Lackey, Senior Program Manager, US Water Alliance

2:00pm Coffee and Stretch Break

2:05pm Case Example: Cleveland, OH
Bianca Butts, Neighborhood Services Coordinator, Burten, Bell, Carr Development, Inc.
Kristin Hall, Director, City of Cleveland Mayor's Office of Sustainability
Collaboration for green infrastructure, sustainability, and the Climate Champions program.

2:25pm Q&A with Cleveland Team
Facilitator: Katy Lackey, Senior Program Manager, US Water Alliance

2:35pm Reflection Exercise: Water Equity and Climate Resilience in Your City/Town
Facilitators: Zoe Roller, Senior Program Manager, US Water Alliance
Staff will guide participations through an individual and group reflection to further understanding of water equity in their own roles and locations. Questions may include:

- Do you see water equity issues showing up in your utility and/or city/town?
- What neighborhoods are vulnerable to climate impacts in your city/town?
- Who could you collaborate with on water equity issues?
- What steps could you take now to address water equity in your utility or community?

2:55pm Closing Reflections
Gina Wammock, Senior Fellow, US Water Alliance

GLISA - Agenda

Science, Tools presentations, Tools café, Tools survey, Panel with Q&A

Great Lakes precipitation trends

Tools presentations

1. NOAA Atlas 14 Point Precipitation Frequency Estimates - Michael St. Laurent, NOAA Office of Water Prediction - National Water Center
2. NOAA Quantitative Precipitation Forecasts - Nancy Beller-Simms, NOAA Climate Program Office - Sectoral Applications Research Program
3. NOAA Climate Explorer - Nancy Beller-Simms, NOAA Climate Program Office - Sectoral Applications Research Program.
4. EPA National Stormwater Calculator - Jason Bernagros, U.S. EPA Office of Research and Development.

Virtual tools cafe

Tools survey

Stormwater panel Q&A

MARISA-CCRUN - Agenda

1.5-day in person workshop – Preworkshop survey, Science and technical overviews, Case studies, Tools cafes, Interactive discussions, Polling

The goal of this workshop is to bring together planning and technical leads from utilities and agencies across the Mid-Atlantic region to exchange ideas, discuss best practices, successes, and lessons learned regarding planning for extreme events and climate change in stormwater management. This workshop is targeted to leaders representing medium- to smaller-sized utilities in the region with responsibilities

for stormwater planning and management as well as their associated engineers, consultants, and other staff members involved in the technical aspects of stormwater management.

Day 1 – March 5, 2020
an overview of the regulatory context; identify management methods relevant to climate resilience, scenario inputs, and modeling tools needed to support stormwater and urban flood risk planning; and discuss policy levers and challenges to implementation.
Day 2 - March 6, 2020
a more technical focus and will provide a synthesis of the state of the art in extreme precipitation forecasting and its inclusion in stormwater planning.

Day 1

Pre Workshop Survey

Session 1: Stage-Setting and Regulatory Context - Moderator/Facilitator: Debra Knopman (MARISA/RAND)
• Adriana Caldarelli (The Water Environment Federation)
• James Stitt (Pittsburgh Water and Sewer Authority)

Discussion

Session 2: Climate, Scenario Inputs, and Modeling tools - Moderator/Facilitator: Michelle Miro (MARISA/RAND)
• Franco Montalto (CCRUN/Drexel University)
• C.J. Bodnar and Toni Utterback (City of Virginia Beach, VA)

Discussion

NOAA Tools Café (Featuring Tides and Currents)

Session 3: Policy Levers and Implementation - Moderators/Facilitators: Jordan Fischbach (MARISA/RAND) and Alan Cohn (NYC DEP)
• Doug Beaver (City of Norfolk, VA)

Discussions:
• Part 1: Levers
• Part 2: Information Needs
• Part 3: Prioritization
• Part 4: Conclusion

Poll: rank your highest priority research or decision support need

Day 2

NOAA Tools Café (Featuring Atlas 14)

Session 1: Setting the Stage - Franco Montalto (CCRUN/Drexel University)
• Presentation and discussion of survey results

NOAA Tools Café (Featuring Historical Weather Observations)

Session 2: Future Precipitation Uncertainty and Change

• Radley Horton (CCRUN/Columbia University)
• Daniel Bader (CCRUN/Columbia University)

Tools Café/demo

Session 3: State of the Art – Climate Change in Stormwater Planning
• Mark Maimone (CDM Smith)
• Franco Montalto (CCRUN/Drexel University)

Interactive discussion: Do these methods satisfy participant needs?

NRCC - Agenda

(4) 2-hr. webinars, (3) pre-workshop webinars – Science, Tool demos, Case Studies, Hands on breakouts

Session 1: Extreme Precipitation July 14
Session 2: Drought July 16
Session 3: Flooding July 28
Session 4: Weather & Climate Info for Risk Assessment & Planning

Pre-workshop webinars:
- *Planning for Weather & Climate*: Climate Resilience Toolkit
- *Drought*: U.S. Drought Monitor
- *Extreme Precipitation*: NOAA Atlas 14 & Extreme Precipitation in New England

Session 1: Extreme Precipitation July 14
- Climate Info - Overview of historical & future extreme precipitation trends
- Planning for Bad Weather: A Utility's Perspective - Portland Water District (Paul Thomas Hunt)
- Demo: NOAA Atlas 14 - Precipitation Frequency
- Demo: Precip.net Extreme Precipitation in New England.
- Hands-on Breakouts of NOAA Atlas 14 - Precipitation Frequency Atlas
- Hands-on Breakouts of Precip.net Extreme Precipitation in New England

Session 2: Drought July 16
- Drought Response & Recovery: Town of Castine, ME
- Climate Info
- Demo: United States Drought Monitor (USDM)
- Demo: EPA Drought Response and Recovery Guide
- Hands-on Breakouts
  United States Drought Monitor (USDM)
- EPA Drought Response and Recovery Guide

Session 3: Flooding July 28
- Climate Info - Overview of historical floods in the region.
  EPA Intro
- Boston Water & Sewer Commission
- NWS Northeast River Forecast Center (NERFC)
- EPA Stormwater Calculator (SWC) & Storm Water Management Model (SWMM)

Session 4: Weather & Climate Info for Risk Assessment & Planning July 30
- Cambridge Flood Viewer
- CT Utility Resilience Work
- NOAA Climate Resilience Toolkit & Climate Explorer
- Intensity Duration Frequency Curves - Future Projections for a Changing Climate
- Final Notes

PNW - Agenda

Three webinars with presentations on utility experiences, presentations on available climate related tools and data, Q&A, and break out groups.

Webinar 1: Tuesday, August 11, 9:00am-10:30am PT
Learning How to Adapt to a Changing Climate: A Collection of Case Studies from Water Agencies Throughout the U.S.,
Presenter: Julie Vano | Research Director, Aspen Global Change Institute
This webinar will highlight best practices for water utilities interested in incorporating climate change information into their planning and water management. To do so, it will draw on real-world examples from utilities across the United States.
After the presentation, break out groups will discuss leading practices and report back to the larger group.

Webinar 2: August 18, 9:00am-10:30am PT
Climate Adaptation in Public Works
Presenter: Fred Buckenmeyer | Director, City of Anacortes - Public Works
In 2003, the City of Anacortes, WA, realized that climate change-driven changes in streamflow, sediment, and sea level rise threatened the city's water treatment plant. By 2008, however, it was clear that moving the plant would be too costly for the city of 17,000. In this webinar, Fred Buckenmeyer, the Director of Public Works at the city of Anacortes, will share how Anacortes designed its new water treatment plant to account for these climate risks. The webinar will also address Anacortes' recent analysis of its wastewater system, which the city conducted to ensure that it has capacity for current and future rain events.

The Climate Toolbox, a.k.a. The Northwest Climate Toolbox
Presenter: Katherine Hegewisch | University of California, Merced
This presentation will demonstrate the Climate Toolbox (climatetoolbox.org).

Webinar 3: August 25, 9:00am-10:30am PT
Throw Away Your Crystal Ball: A Stress Testing Approach to Infrastructure Planning Under Climate Change Uncertainty
Presenter: Nishant Parulekar | Civil Engineer, City of Portland - Bureau of Environmental Services
Uncertainty and extreme scenarios can make using climate models a challenge. In this webinar, Nishant Parulekar of the City of Portland Bureau of Environmental Services (BES) will share how BES responded to this challenge by piloting a new technique to understand how its wastewater and stormwater systems would perform under a range of precipitation conditions. Nishant will describe how BES conducted a sensitivity analysis of its system to determine thresholds for impacts that the utility could then compare to climate projections.

Tool Presentation
Presenter: Guillaume Mauger | Climate Impacts Group, University of Washington
This presentation will provide a high level overview of the U.S. Climate Resilience Toolkit, the Water Resources Dashboard, and EPA's Creating Resilient Utilities.

These webinars will be hosted by the University of Washington Climate Impacts Group and University of Minnesota, supported by funding from the Water Research Foundation.

SERCC - Agenda

One on one interviews; debrief with National Project Team

SCIPP - Agenda

Science presentations, Tools demos, Case studies, Equity presentation, Discussions_

State of the Science Overview

- Dr. Barry Keim (Louisiana State Climatologist & Professor, Louisiana State University). "Climate across Louisiana: Historical Trends and Drivers of Variability"
- Dr. Vincent Brown (Assistant Professor-Research, Louisiana State University). "Climate Change and Precipitation".
- Amanda Lewis (Research Climatologist, Louisiana State University). "An Overview of Projected Climatic Changes".

Overview of NOAA's Common Tools.

- Tool 1: Climate Explorer
- Tool 2: NOAA Atlas 14
- Tool 3: Tropical Weather Outlooks, Quantitative Precipitation Forecasts University

Setting the Stage: Water Utility Perspectives

- Michael Sobert (General Manager, Terrebonne Parish Consolidated Water Works).
- Tyler Antrup (Director of Planning + Strategy, SWBNO).

Breakout Session on Critical Thresholds

Planning For Resilience

- Katy Lackey (Senior Program Manager, US Water Alliance)
- Zoe Roller (Senior Program Manager, US Water Alliance)
- Jessica Dandridge (Executive Director, Water Collaborative)

Breakout Session on Water Equity and Climate Resilience in Your City/Town

Closing Thoughts/Next Steps.

WWA - Agenda

Science presentations, Tool demos, Panel discussion, Breakout session discussions.

Snowpack, Drought and Water Supply in a Warming Mountain West
August 4-5, 2020

Workshop goals: This virtual workshop will connect water professionals in the Mountain West with the latest usable scientific information and tools about snowpack, drought, and water supply, and support learning across water providers. Sponsored by the NOAA Climate Program Office, the workshop will feature talks from scientists and water professionals on the current water year, and on recent trends and future projections in snowpack, drought and water supply. In addition, we will provide demonstrations of several tools and data sources on this topic. There will be several opportunities to engage in discussions with scientists, water managers, and other experts, including a panel discussion with several water utilities.

Day 1

Presentation. The water-year in review, current drought outlook, and forecasts (Paul Miller, CBRFC)

Breakout session #1. Preparing for the 2020 runoff season. What information (snow data,

streamflow forecasts, etc.) did you use to prepare for the runoff season? Were you surprised by the way things played out?
Tools demonstration. How do we get the data that goes into the water year in review presentation? (Seth Arens and Lineke Woelders, Western Water Assessment)

Presentation. Recent trends in snowpack, drought and water supply in the Mountain West (Becky Bolinger, Colorado Climate Center, CSU)

Breakout session #2. Local changes to snowpack and water supply . Have you observed these regional changes in your own watersheds and systems? What have been the impacts of these changes?

Presentation. Future projections in regional water supply, snowpack and drought (Seth Arens, Western Water Assessment)

Day 2

Presentation and tools demonstration. The new Snowpack Information User Guide: Introduction and demonstration of snowpack information tools (Jeff Lukas and Lineke Woelders, Western Water Assessment)

Presentation. Denver Water: Tools and data for water decisions (Nathan Elder, Denver Water)

Panel Discussion. How do small-medium water utilities use climate information? A discussion with Mountain West water managers. (Dena Egenhoff - City of Cheyenne Board of Public Utilities; Jarrod Biggs - City of Durango; Jon Parry - Weber Basin Water Conservancy District; Meagan Smith - City of Fort Collins)

Presentation. The Water Utility Climate Alliance: Recent work with small-medium utilities (Laurna Kaatz, Denver Water)

Breakout session #3. Water provider decision-making and climate information . Have your experiences been similar to the panelists? How have they differed? How would you like to use climate information in the future? Are there any barriers that make this difficult?

Acknowledgments

NOAA and the Water Research Foundation wish to express our sincere appreciation to everyone who participated in this workshop series. Following is the complete list of everyone we wish to acknowledge including speakers, advisors, and associates who were all crucial to the success of this project.

Workshop Series National Management Team and Associates

- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program
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- Tamara Houston, National Partnership Liaison, NOAA National Centers for Environmental Information
- Maureen Hodgins, Regional Liaison, Water Research Foundation
- Katy Lackey, Senior Program Manager, US Water Alliance
- Karen Metchis, Contractor, ACQ Consulting, LLC

Associates

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- Ned Gardiner, PhD, U.S. Climate Resilience Toolbox Engagement Manager, Contractor, CollabraLink Technologies, Inc.
- Jennifer Dopkowski, Climate and Societal Interactions Program, NOAA Climate Program Office
- Jack Barker, B.A., Environmental Studies, 2022, Intern, NOAA Climate Program Office

Water Utility Study Planning Partners

Water Resource Dashboard Partners

- Erica Brown, Association of American Water Agencies
- Kenan Ozekin, Alison Deines, Harry Zhang, Water Research Foundation
- Adam Carpenter, American Water Works Association
- Claudio Ternidien, Water Environment Federation
- Shannon Burke, Joe DeAngelis, American Planning Association
- Katy Lackey, US Water Alliance
- Ted Stiger, National Rural Water Association
- Jeff Oxenford, Rural Community Assistance Partnership

Partners Outside Federal Government

- Laurna Kaatz, Mohammud Mahmoud, Water Utility Climate Alliance
- Kristina Surfus , National Association of Clean Water Agencies
- Sean Rolland, Jason Hobbs, Association. of Clean Water Administrators
- Deirdre White, Association of State Drinking Water Admin.
- Kristin Baja, Urban Sustainability Directors Network
- Alan Cohn, New York City Water
- Julia Rockwell, Philadelphia
- Gerry Galloway, University of Maryland
- Andrew Kricun, Camden County Municipal Utilities Authority

Other Federal Partners

- Curt Baronowski, Steve Fries, Stephanie Santell, U.S. Environmental Protection Agency

NOAA

- Wayne Higgins, Ben DeAngelo, NOAA/OAR/CPO
- Claudia Nierenberg , NOAA/OAR/CPO
- Adrienne Antoine, Jen Dopkowski, NOAA/OAR/CPO
- Caitlin Simpson, Chelsea Combest-Friedman, NOAA/OAR/CPO
- David Herring, Ned Gardiner, NOAA/OAR/CPO
- Veva Deheza, NOAA/OAR/CPO/NIDIS
- Miki Schmidt, NOAA/NOS/OCM
- Trey Flowers, NOAA/NWS/OWP/NWC
- Mary Mullusky, NOAA/NWS/OWP
- Karen Bereford, contract to NOAA/NWC
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- Gina Wammock, Senior Fellow, US Water Alliance
- Deborah Lee, Director, NOAA Great Lakes Environmental Research
- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program

Speakers

- Elizabeth Rohring, Engagement Lead, NOAA Sea Grant, U.S. Department of Commerce
- Bianca Butts, Neighborhood Services Coordinator, Burten, Bell, Carr Development, Inc.
- Kristin Hall, Director, City of Cleveland, Mayor's Office of Sustainability
- Yvonne McCaskill, Coordinator, Century City Triangle Neighborhood Association
- Lisa Sasso, Senior Project Planner, Milwaukee Metropolitan Sewerage District

GLISA

Planning Team

- Kim Channell, Great Lakes Integrated Sciences and Assessments
- Jenna Jorns, PhD, Great Lakes Integrated Sciences and Assessments
- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program

Speakers

- Maria Carmen Lemos, PhD GLISA
- Matt Naud, GLISA
- Michael St. Laurent, NOAA Office of Water Prediction, National Water Center
- Jason Bernagros, U.S. EPA Office of Research and Development
- Frank Greenland, Northeast Ohio Regional Sewer District
- Cameron Davis, JD, City of Ann Arbor
- Jerry Hancock, Metropolitan Water Reclamation District of Greater Chicago

Advisory Team

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- Julie Vano, PhD, Aspen Global Change Institute
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- Catherine Kemp, M.S. Candidate, Master of Urban and Regional Planning, Environmental Policy and Planning , Graduate Research Assistant, GLISA
- Sarah Hutchinson, GLISA
- Eva Gnegy, GLISA
- Jennifer Warner, Water Research Foundation
- Kumar Jensen, City of Evanston

MARISA-CCRUN

Planning Team

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- Korin Tangtrakul, Consortium for Climate Risk in the Urban Northeast (CCRUN), Drexel University
- Debra Knopman, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the

RAND Corporation
- Jordan Fischbach, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the RAND Corporation
- Krista Romita Grocholski, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the RAND Corporation
- Michelle Miro, Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA); and the RAND Corporation
- Ellen Mecray, Regional Climate Services Director, Eastern Region, NOAA National Centers for Environmental Information

Presenters and Speakers

- Doug Beaver, Chief Resilience Officer, City of Norfolk, VA
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- C.J. Bodnar, Technical Services Manager, Public Works Stormwater Engineering Center, Virginia Beach, VA
- Mark Maimone, Senior Vice President, CDM Smith
- Ziwen Yu, Assistant Professor at the University of Florida
- Eric Rosenberg, Associate, Hazen and Sawyer; Adjunct Professor, Columbia University
- Art DeGaetano, Professor, Cornell University
- Daniel Bader, Consortium for Climate Risk in the Urban Northeast (CCRUN), Columbia University
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- Newton Tedder, EPA Region 1
- Paul Thomas Hunt, Portland Water District
- Ed Capone, NOAA/NWS Northeast River Forecast Center, retired
- Annaleis Hafford, Oliver Associates
- Deborah Bathke, PhD, National Drought Mitigation Center
- Lynn Gilleland, EPA Region 1
- David Vallee, NOAA/NWS Northeast River Forecast Center
- Charlie Jewell, Boston Water & Sewer Commission
- Jeane Wallace, NOAA/NWS Northeast River Forecast Center
- Jason Bernaros, EPA Office of Research & Development
- John Bolduc, Cambridge, MA
- Christine Kirchhoff, PhD, University of Connecticut

- Jeri Weiss, EPA Region 1
- Sylvia Reeves, National Integrated Drought Information System
- Elise Simons, EPA New England
- Jennifer Warner, Water Research Foundation
- Stephen Estes-Smargias, Massachusetts Water Resources Authority
- Stacey Herbold, NH Department of Environmental Services
- Ben Sweeney, NH Department of Environmental Services
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- Heidi Roop, PhD, University of Minnesota, Department of Soil, Water, and Climate
- Julie Tolmie, University of Washington, Climate Impacts Group
- Maureen Hodgins, Regional Liaison, The Water Research Foundation

Speakers

- Julie Vano, PhD, Research Director, Aspen Global Change Institute
- Fred Buckenmeyer, Director of Public Works, City of Anacortes
- Nishant Parulekar, Civil Engineer, City of Portland Bureau of Environmental Services
- Katherine Hegewisch, PhD, Data Scientist, University of California Merced

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- Karl Morgenstern, Water Resources & Quality Assurance Supervisor, Eugene Water & Electric Board
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- Brenna Sweetman, Social Scientist, NOAA Office for Coastal Management

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- Clay Tucker, Facilitator, Louisiana State University
- Ashlee Autore, Graduate Student, Louisiana State University
- Marisa Karpinski, Graduate Student, Louisiana State University
- Derek Thompson, Graduate Student, Louisiana State University
- Nancy Beller-Simms, PhD, Lead, Water Risk Team, NOAA Climate Program Office, Adaptation Sciences Program

Speakers

- Michael Sorbert, General Manager, Terrebonne Parish Consolidated Waterworks
- Tyler Antrup, Director of Planning and Strategy, New Orleans Sewerage and Water Board
- Jessica Dandridge, The Water Collaborative of Greater New Orleans
- Katy Lackey, US Water Alliance

SERCC

Planning Team

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- Charles E. Konrad, Ph.D., Southeast Regional Climate Center, Carolinas Integrated Science and Assessments
- Tamara Houston, National Partnership Liaison, NOAA National Centers for Environmental Information

Interviewees

- Tirusew Asefa, PhD, Tampa Bay Water , FL
- Amanda Berger – AQUA NC
- Shaun Armistead and Team - Metropolitan Sewerage District of Buncombe County, NC
- Ruth Rouse and Allison Spinelli - Orange Water And Sewer Authority, NC
- Joe Mantua – Beaufort-Jasper Water And Sewer Authority, SC
- Carl Alexander – Greenwood Commissioners Of Public Works, SC
- Jeff Chapman and Team - Greenwood Metropolitan District , SC

WWA

Planning Team

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- Paul Miller, Colorado Basin River Forecast Center, NOAA
- Jeff Lukas, WWA, CIRES, University of Colorado
- Laurna Kaatz, Climate Program Director, Denver Water
- Dena Egenhoff, City of Cheyenne Board of Public Utilities
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- Jon Parry, Weber Basin Water Conservancy District
- Meagan Smith, Water Resources Engineer, Fort Collins Utilities

The Water Resources Dashboard: Purpose, History, and Evolution

The Water Resources Dashboard is an evolving platform that seeks to make NOAA's water-related weather and climate information more accessible to water resources managers, including water and wastewater utilities, stormwater managers, public works engineers, and planners. It is the result of long-standing collaborations with the water sector. The site includes past and current observations, near- and mid-term outlooks, and projections for long-term climate change. Data sets include weather, storms, precipitation, soil moisture, snow, stream flow, and other data sites of importance to a variety of water resource managers. An additional section provides links to other resource portals and planning assistance.

The Dashboard provides a central location for finding a variety of data and information sources without having to search through the wide array of websites offered throughout NOAA. The dashboard includes a thumbnail description of the data source, a direct link, and in many cases a video demo and a case study of how the data source was used in local decision making.

Users can find information in two ways, both offered on the main landing page. Users who know what data set they are looking for can simply scroll down to find the link. Alternatively, a user-friendly interrogation helps users find information to answer common questions.

History of the Dashboard

NOAA has been working with the U.S. Global Change Research Program since the early 2000's to improve the federal government's ability to provide climate and weather information for communities. As part of that effort, NOAA's Climate Program Office, Climate and Societal Interactions Division and NOAA's National Centers for Environmental Information have been working in particular with stakeholders in the water sector to support their efforts to build resilience to a changing climate.

Water Sector Engagement

In 2010, to gather stakeholder perspectives, NOAA, NASA, USEPA, WERF and WaterRF convened a research forum that was attended by more than 80 water utilities and water managers. Their concerns focused on three primary cross-cutting issues: coastal adaptation, extreme events, and the energy-water nexus.

In response in 2011/2012, NOAA again joined with USEPA, WERF, and WaterRF as well as AWWA, WEF, and Noblis to understand water sector needs to address extreme events. The project entailed a series of workshops across the country that examined the actions taken by water and wastewater utility practitioners who had recently faced one or more extreme weather events to understand their planning and response and information needed for making decisions to plan for and respond to extreme events. The final report, published by WERF, consists of a series of case studies highlighting lessons learned and recommended actions along with a detailed report. One of the key takeaways from talking with local water utilities was the request for a way to make the most useful information more readily accessible to planners and decision makers – a sort of "dashboard".

Creation of the Dashboard

To meet stakeholder requests, NOAA convened a working group involving AWWA, AMWA, WERF, WaterRF, and the American Planning Association to help identify what information would be of most importance for the water sector for inclusion in a Dashboard. Each association queried their own members to identify most often used, and most needed, resources. Stakeholders requested simplified access to data sources as well as guidance and training on how to use them. Their feedback provided the basis for design of the Water Resources Dashboard which was rolled out in 2016.

Evolution of the Dashboard

After several years, it became evident that the Dashboard was not being used by water managers in small- to medium-sized communities. To address this gap, in 2020 NOAA and the Water Research

Foundation again convened a series of regional workshops planned by regional partners such as the NOAA RISAs, Regional Climate Centers, universities, the U.S. Water Alliance, and other partners and tailored to regional needs. The project provided NOAA as well as the workshop participants a more in-depth understanding of local scale service providers and the information they need for near- and long-term planning. Among several important takeaways: smaller system managers don't have the time or skill to search through the plethora of NOAA's offerings to find information; their preferred sources of guidance and training are their regional peers and professional networks; and they are in need of more local scale data including improved soil moisture and snowpack monitoring, understanding changes in precipitation and cloudbursts, and standards for integrating changes in weather and precipitation into hydrological modeling and tools; among other needs. Results of the workshop series are documented in an overall project summary as well as summary proceedings of each of the regional workshops.

The Future

As of November 2020, NOAA has initiated revisions to the Dashboard but it is clear that improvements are still needed to simplify how communities can find the information they are seeking. Beyond the Dashboard, however, NOAA will continue to collaborate with stakeholders, water sector professional associations, and other federal agencies to support training, build integrated tools, and improve access to information and to ensure that information is relevant, useful, and accessible to community decision makers.